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Spatial patterns of production linkages in the context of Europe's small towns: How are rural firms linked to the local economy?[1]

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Abstract

Small towns have received increasing attention from policy makers aiming to stimulate rural development through territorial approaches. However, it cannot be assumed that fostering local business growth will help generate local economic development, either through economies of agglomeration or through spillover effects into surrounding locales. This paper examines the spatial economic behaviour of firms located in and around thirty towns across five European countries. It tests a number of hypotheses regarding the influence of various characteristics on the strength of local economic integration: organisational characteristics, local contextual characteristics and characteristics of the potential links between the firm and local markets. Findings reveal that the more 'traditional' and less productive rural firms exhibit stronger ties to their locality and the size of the local intermediate goods market influences the extent to which firms source locally. Differences in terms of country, area and town size highlight the importance of local contexts in explaining patterns of spatial economic behaviour.

La question du rôle des bourgs et petites villes dans le développement rural est souvent placée au coeur de certaines politiques territoriales. On peut cependant se demander si la stimulation de la croissance de l'activité économique locale se traduit toujours par un regain de croissance économique locale à travers le jeu des économies d'agglomération ou au travers d'effets de spillovers locaux. Le présent article examine le comportement économique spatial de firmes localisées dans 30 petites villes et leur territoire d'influence de 5 pays européens. Les hypothèses testées relèvent de trois registres permettant d'expliquer l'intensité du degré d'intégration économique locale des achats d'inputs et des ventes d'outputs des firmes. On examine donc conjointement le rôle des caractéristiques individuelles des firmes et des entrepreneurs, celui des

caractéristiques du contexte local dans lequel sont insérées les firmes et, celui de la nature des liens que la firme peut nouer avec son environnement économique local au travers des marchés locaux de biens intermédiaires, finaux et du travail. On montre ainsi que les entreprises rurales les plus "traditionnelles" et les moins productives développent un comportement très localement centré, c'est-à-dire concentrent leurs liens économiques tant de ventes que d'achats sur les territoires étudiés. De même, la taille du marché local de biens intermédiaires nécessaires au fonctionnement de l'entreprise influence fortement son degré d'intégration économique locale. Enfin, les différences entre pays, taille et nature des territoires ruraux étudiés mettent en évidence l'importance des effets de contexte dans l'explication des configurations de comportement spatial des firmes.

KEYWORDS:

Rural development - Rural firms - Local economic integration - Small towns

JEL CODES:

R - Urban, Rural, and Regional Economics

R0 – General

R1 - General Regional Economics

R12 - Size and Spatial Distributions of Regional Economic Activity

R15 - Econometric and Input-Output Models

R3 - Production Analysis and Firm Location

R39 - Other

INTRODUCTION

Small towns have traditionally formed an integral part of the agricultural sector and wider rural economy, acting as a source of farm inputs, a first destination of farm outputs and as a source of consumer goods and services to farm households. In recent years, this relationship has been substantially eroded through processes of socio-economic restructuring, including the transformation of agriculture and a decline in other primary industries (See MARSDEN *et al.,* 1993; HODGE and MONK, 1987; NEWBY, 1985; CHAMPION, 1989). Further, a number of endogenous and exogenous drivers have resulted in the uneven development of rural economies throughout Europe, leading not only to disparities (See BRYDEN and HART, 2001; TERLUIN and POST, 2000; TERLUIN, 2002) but also to the decline of small and medium-sized towns as thriving economic and service centres (See POWE and SHAW, 2004; THOMAS and BROMLEY, 2002; COURTNEY and ERRINGTON, 2000).

As a result, these settlements have received increasing attention from policy makers aiming both to maintain the traditional socio-economic fabric of rural areas, and to stimulate rural development through territorial, as opposed to sectoral – and namely agricultural – approaches. However, it cannot be assumed that fostering business growth in and around these settlements will help generate local economic development, either through economies of agglomeration or through spillover effects into the surrounding countryside. On the contrary, the expansion of economic activity within a particular town might simply lead to an increase in imports and commuter flows from other regions or neighbouring cities, with relatively few benefits to the town or surrounding rural area. It is therefore necessary to understand and evaluate the nature of production linkages between firms in and around small towns in order to assess their potential role in generating local economic development.

Two aspects of production linkages are important in this context: 1) the characteristics of firms and their environment most associated with local economic behaviour; and 2) the types, and patterns, of linkages which are most likely to help stimulate local economic development in and around small towns. For example, the potential for local economic growth will in part be determined by the capacity of firms to generate income through export activity and, it is argued, to generate *net* income through exports combined with local sourcing to prevent income leakage out of the area (PERSKY *et al.,* 1993; WILLIAMS, 1997). Therefore, the identification of firm characteristics associated with not only different types of local linkage, but also different combinations of spatial economic behaviour (in terms of sales, purchases and employment), is useful in a local development context. This is especially relevant in the context of a small town where the levels of inter-dependence between local producers and consumers may ultimately determine the potential for creating or maintaining a balanced, sustainable community.

While a number of local and regional studies of economic linkages serve to indicate those firm characteristics and contextual factors most likely to be associated with strong local economic integration (See for example CURRAN and BLACKBURN, 1994; COURTNEY and ERRINGTON, 2000), further testable hypotheses may be derived from theoretical approaches of the economic geography. This framework puts at the heart of the location process imperfect (*i.e.* monopolistic) competition, increasing returns, transportation costs and therefore size of the local final demand market, strength of local vertical linkages and differential local labour costs (see for details KRUGMAN, 1991; KRUGMAN and VENABLES, 1995; FUJITA *et al.*, 1999; or, FUJITA and THISSE, 2002). Findings from a number of related studies (See COMBES and OVERMAN, 2004; or, OVERMAN *et al.*, 2001) have subsequently emphasised the important role of the 'home market effect' (*i.e.* size of the local final demand market) on the geographical concentration of firms, as well as the influence of vertical linkages. If these factors do influence the location process

of firms, it follows that they may also influence the spatial economic behaviour of rural firms, and in turn their potential in fostering local economic development.

Using primary data collected in thirty case study areas across five European countries, this paper examines the nature and strength of spatial economic linkages in and around small town economies. The research aims to build on the existing literature in two important ways. First, as well as examining conventional organisational characteristics associated with strong and weak local economic integration, it also attempts to: (i) consider the potential role of different national contexts and of firms' technological characteristics (labour productivity, unskilled workforce, etc.) in explaining levels of integration; and (ii) open the 'black box' of local contextual factors by examining the role of linkages between firms and local demand and input markets in influencing the degree of local integration, as suggested by the economic geography theoretical framework. Second, by differentiating between various patterns of spatial economic behaviours throughout the wider economy, the analyses aim to assess the relevance of the observed production linkages to local economic development in small towns' economies; in particular identifying those characteristics and contextual factors associated with the potential to both generate external income and stimulate local multipliers through sourcing and employment.

LITERATURE REVIEW AND THEORETICAL CONTEXT

The following review is divided into three main sections. The first provides a brief outline of export base and net income theories in order to rationalise the need for examining both upstream and downstream linkages in the local economy. The second goes on to review findings from some previous studies of first round linkages, which serve to indicate the firm characteristics likely to be associated with strong local economic integration, and in turn to help develop some hypotheses to be tested in the present study. To go beyond the usual contextual features, the third section makes

reference to theoretical approaches of the economic geography, which provide further bases for hypotheses testing.

Export base and net income theories in local development

Conventional local economic development theory and practice is grounded in economic base theory, which assumes that an economy must earn external income in order to grow. This approach distinguishes between 'basic' activities (such as manufacturing or agricultural production, for example), which generate products that are exported from the locality, earning external income and thus acting as engines for growth, and 'non-basic' activities (such as consumer services[1]) which merely circulate income in an economy. In consequence, the principal focus of local economic development has been on cultivating 'basic' sectors, prioritising sectors simply by their ability to export. This theory assumes that extra-local downstream linkages are of key importance to achieving economic growth and overlooks the role of locally orientated activities which stimulate the local economy by preventing income leakage. Any leakage of income out of the local economy will tend to reduce the levels of profit and salaries that are available within the area.

Indeed, there is evidence to suggest that the growth of a local economy is dependent on both attracting external income and preventing the leakage of income out of the area (See PERSKY *et al.,* 1993). As WILLIAMS, 1997, argues, what is needed for an economy to grow is not a rise in external income alone but a rise in *net income,* which is determined by total external income, times a multiplier (which is larger the more self-reliant the economy), minus total external spending. If imported goods and services begin to be produced locally then net income may be increased without a rise in exports. This will tend to increase both the diversity of local economic activity and its degree of interconnectedness (POWER, 1988).

Net income theory provides a useful basis for exploring local economic development strategies in small towns, where the strength of local multipliers are key to achieving the desired trickle down effects. Since small towns contain both producers and consumers, there is a clear case for fostering not only 'basic' sectors which generate external income, but also 'non-basic' activities which source locally, helping to prevent leakages and thus increasing the size of local multipliers. Of course, both sectors will help to stimulate local multipliers through induced effects if their employees live locally. Thus, any meaningful examination of local economic integration[2] in and around small towns should encompass sales (downstream), purchases (upstream) and employment linkages.

In order to examine how open these linkages are to manipulation through policy and planning, it is important to assess how they differentiate between various types of entity and environment. In the light of this, attention now turns to the characteristics which potentially influence the relative strength of local economic integration.

Previous studies of first round linkages

Previous studies of first round linkages have identified a number of characteristics which appear to influence the degree of local economic integration. These can be divided into three broad types: 1) sectoral, 2) organisational and 3) locational (or contextual) characteristics.

1) Findings from previous studies indicate that private services have stronger economic linkages, particularly in terms of sales patterns, with the locality than do manufacturing firms. Consumer services have been found to have stronger direct upstream local linkages than all other sectors and business services have been found to source more locally than the manufacturing sector (WILLIAMS, 1994; CURRAN and BLACKBURN, 1994; ERRINGTON, 1994; COURTNEY and ERRINGTON, 2000). WILLIAMS, 1994, also found that the construction sector tended to both source and sell more locally than the manufacturing sector.

2) Organisational characteristics which have been found to influence the degree of local economic integration of individual businesses include firm size, ownership and age. Small firms have been found to source more inputs locally compared to larger firms (COURTNEY and ERRINGTON, 2000; HARRISON, 1993; ERRINGTON, 1994). There is also some evidence to suggest that smaller firms exhibit stronger linkages to their locality in terms of customer base, than larger firms (CURRAN and BLACKBURN, 1994; ERRINGTON, 1994; HARRISON, 1993). A number of studies have found that independent firms source a higher proportion of their inputs locally, and are therefore more strongly tied to locality than branches of national and multi-national corporations (COURTNEY and ERRINGTON, 2000; GRIPAIOS *et al.*, 1989; DOBSON, 1985). With respect to firm age, NORTH and SMALLBONE, 1996, and CURRAN and BLACKBURN, 1994, found that the majority of rural SMEs turn to local market opportunities at their initial stages of operation, a pattern which is especially evident in craft-based firms.

Characteristics of the firm owner/manager have also been revealed as potentially important indicators of spatial behaviour in rural firms. In his work on the sourcing of business services by firms in southern England, MILLS, 2002, developed the concept of the indigeneity[3] of firms and explored its association with the spatial distribution of this particular sub-set of economic transactions. Findings indicated a negative relationship between the distance from the owner/manager's previous domicile and the degree of local sourcing. Further qualitative enquiry suggested that indigeneity was an important factor influencing sourcing decision-making by owner/managers in small rural producer services.

Some potentially influential organisational characteristics do, however, appear to be have been neglected in this literature. In the context of local economic development, the efficiency and productivity of rural firms might also be a useful basis for differentiation. For example, one might

hypothesise that more productive firms will exhibit weaker levels of local integration because they reach out to, or have access to, wider markets. Likewise, firms that spend a greater proportion of their turnover on intermediate goods and raw materials may do so because, by sourcing more locally they have a limited supply base. Alternatively they may choose to source locally to reduce transactions costs or stay loyal to local suppliers and networks to the detriment of purchasing costs.

3) Previous studies of linkages and service provision in and around small towns go some way to quantifying the importance of locational, or contextual, factors on local activity patterns. In particular, the relative proximity of towns to urban centres appears to be a potentially important predictor of the strength of local integration, as does location within the rural settlement hierarchy itself. Both COURTNEY and ERRINGTON, 2000, and MITCHELL *et al.,* 2005, found that firms located in more remote regions tended to exhibit stronger linkages to locality, in terms of sales, purchases and employment.

There is potential to control for further contextual factors when examining the spatial patterns of rural production linkages. In terms of employment, rural economies in Europe can be broadly differentiated by their relative dependence on sectoral employment, of which agriculture and tourism are particularly important. It is reasonable to assume that firms located in areas dominated by tourism might exhibit stronger sales linkages to the wider economy due to the nature of the industry, although because firms may draw more on local niche markets to market produce, local upstream linkages may in fact be relatively strong. Likewise, previous studies have not considered the potential influence of town size on the spatial distribution of production linkages. For example, one might hypothesise that larger towns have the ability to generate higher multipliers through economies of scale.

Some locational factors have also been considered within study areas, in particular focusing on the differences between town and hinterland locations in terms of local integration. Again both COURTNEY and ERRINGTON, 2000, and MITCHELL *et al.,* 2005, found that firms located within the town tended to have stronger linkages to town economies than those located in the rural hinterland. This may have implications for planning and policy in terms of local economic development, and thus represents a useful hypothesis to test. However, a number of other contextual factors appear to be overlooked, in particular the potential relationship between local economic integration and competition, market size and labour market structure. To rationalise these we turn to theoretical approaches of the economic geography.

Theoretical approaches of the economic geography

Based on general equilibrium models under monopolistic competition, characterised by increasing returns, transport costs and consumer preference the economic geography approaches emphasise the role of output demand, input supply and demand and labour supply on industrial firm location decisions (FUJITA *et al.*, 1999). Essentially, firms will choose to locate where the demand for outputs or the supply of intermediate goods are relatively high and where the supply of labour is favourable. In addition, following the traditional spatial economics framework, the competition between firms is stronger when the level of differentiation between their output is low. Thus, in theory firms should be attracted to areas where levels of inter-sectoral competition are relatively weak. These location theories also imply a potential relationship between levels of local competition, intermediate and final demand and labour supply on the strength of local economic integration.

The economic geography literature shows that firms may choose to locate in areas where there is a high concentration of households (KRUGMAN, 1991). In theory, this allows them to both increase the size of their local market and to reduce transport costs. For the same reasons, households might

tend to locate near firms (especially consumer services) in order to obtain a wider consumer choice. In turn, the magnitude of local final demand on the geographical concentration of production, often called the 'Home Market Effect', could also influence the geographical distribution of firm transactions. Essentially, firms located in an area where the market for its output is large may sell more of its products locally. A similar effect could be hypothesised with respect to input markets. KRUGMAN and VENABLES, 1995, showed a positive relationship between the size of the local inputs market and the level of concentration in firms using these inputs. Thus, one could hypothesise that a larger intermediate inputs market will favour a local purchasing behaviour.

In addition, a strong level of competition may deter firms from locating in an area; likewise increasing levels of competition may force local firms to leave the market and disperse more widely. However, as many industries are now more flexible about where they can locate, increasing levels of competition may also cause some firms to remain in the local area but reach out to markets further afield. In terms of the spatial distribution of firm transactions, one could therefore hypothesise that a strong level of local competition within a given sector tends to favour extra-local sales linkages.

The role of linkages between firms and households on the labour market is more ambiguous. When the geographical mobility of workers is perfect, they tend to favour a high level of firm concentration (KRUGMAN, 1991) but when workers are geographically immobile, they tend to foster a wider dispersion of firms (KRUGMAN and VENABLES, 1995; GAIGNÉ *et al.*, 2003). However, these approaches do not take into account the differentiation of workforce mobility by skill level (FUJITA and THISSE, 2002), which may prove crucial in dictating the degree to which firms are able to source skilled labour locally[4], or to which skilled labour may be prepared to commute to take up jobs outside their local area. Thus, by introducing the skills dimension the

hypothesis - that a high proportion of unskilled workers in the local workforce favours a higher degree of local employment integration - can be tested.

The preceding review provides bases for a number of hypotheses to be tested in the present paper. These fall into three categories of factors: organisational characteristics; local contextual characteristics and characteristics of the potential links between the firm and local markets.

In terms of organisational characteristics, one might expect consumer services, the construction sector, small firms and less productive firms to exhibit relatively strong levels of local integration with respect to sales and purchases. Independent firms and those with a local owner/manager are likely to be more locally integrated in terms of upstream linkages and younger firms more locally integrated in terms of downstream activity.

With respect to local contextual characteristics, firms in town locations, those in areas of relatively high agricultural employment and those in larger towns appear most likely to exhibit strong levels of local integration in terms of sales and purchases, although one might expect little difference between agricultural and tourism towns with respect to upstream integration. While there may be substantial differences between European countries in terms of production linkages in and around small towns, as yet it is not possible to speculate about the nature and direction of any such differences.

Finally, elements of the economic geography approach suggest that the potential links between the firm and local markets may represent an important basis for differentiation. Local downstream integration is likely to be stronger where local competition in the relevant sector is weaker and where local final demand is greater. In the same way, local upstream integration is likely to be

stronger where local intermediate demand is greater and local employment integration stronger where the availability of local skilled labour is lower.

DATA COLLECTION AND RESEARCH METHODS

To test our hypotheses we used data collected as part of a trans-national project aiming to explore the spatial distribution of economic transactions in and around 30 small and medium-sized towns and their rural hinterland in 5 European countries (UK, France, The Netherlands, Portugal and Poland). These countries were selected to reflect the varied conditions of the existing and enlarged European Union. While the study examined the economic linkages of firms, farms and households, the present paper focuses only on firms but uses data from the household surveys to help construct some of the variables.

Self-completion survey techniques were developed to measure the extent of economic integration of firms and households into the local, regional, national and international economy. The measure of local integration is based on the proportion of a given entity's total economic transactions (input purchases, output sales, employment) that take place with other entities within given geographical areas. Thus, where a firm exhibits strong integration into the local economy, customers or suppliers in this predefined area account for a large proportion of its respective revenue or expenditure, and a large proportion of its workforce (measured in terms of salary payments) is drawn from this same area.

Selection of case study areas

Selection of towns was made within different types of rural context in order to facilitate a comparison between towns and across different countries. First, we distinguished towns according to their population size. For the purposes of this study, small towns are those with 5,000-10,000 inhabitants and medium-sized towns with 15,000-20,000. Second, we defined three types of rural

area chosen to mirror the differing range of circumstances and contexts across rural Europe: areas where employment in agriculture is well above the national average; areas where employment in tourism is well above the national average; and, 'accessible' peri-urban areas within daily commuting distance of metropolitan centre. Finally, we selected six towns in each country, one small and one medium-sized in each context (See Appendix A for the list of selected towns). In addition, the respective rural hinterlands were defined in terms of a 7 km radius from the town centre.[5]

Survey design and administration

Data were collected via questionnaires designed to allow collection of two types of information. The first set of questions gathered information on the firm's characteristics – the size and type of firm, the size and characteristics of the workforce, the length of time the business had been located in the study area, and the length of time the owner/manager had resided in the local area. The second set of questions sought to allocate particular economic transactions to different zones around the town. The following pre-defined zones were used, with a map provided along with the survey to help ensure accuracy:

- Zone A within the town
- Zone B up to 7 Km from the town
- Zone C 7-16 Km from the town
- Zones D-E elsewhere in the county or in the region
- Zone F elsewhere in the country,
- Zones G-H elsewhere in the EU or in the rest of the world

Information about three types of economic transaction was sought from the firm survey: sales, purchases and employment. The questionnaire focused on the spatial distribution of firm sales and

purchases across the eight pre-defined zones, as well as distinguishing between different types of input. Because a set of questions gathered information about the workforce, it was also possible to define the spatial pattern of firm employment. The household questionnaire focused on spatial patterns of consumer purchases by distinguishing between different categories of goods and services, in turn corresponding to industrial sectors to which local firms could be allocated.

The availability and format of sampling frames varied between the countries, with development of an appropriate 'set' often hindered by variations in geographic units and data quality. In selecting sampling frames two criteria were considered to be of key importance: 1) they needed to cover a large segment of the population and not omit certain sectors or socio-economic groups; and 2) they needed to be as up to date as possible in order to maximise response rates. On the whole this criteria was achieved. After selecting local samples of firms and households, surveys were carried out between September 2002 and May 2003. Usable data was collected for 2,688 firms and 6,116 households located within the 30 study areas, equating to a mean response rate of 20% across all samples Data for each case study area was subsequently weighted according to the breakdown of local industrial employment by Standard Industrial Classification sectors to ensure that multivariate analysis was carried out on broadly representative samples (See Appendix A for details about the number of surveyed firms in each study area and the impact of weighing).[6]

To check for data validity the key dependent variables were compared to criterions recorded directly from a sample of firm invoices and receipts. The validation exercise was carried out in one town in each of the five countries, although in some cases it proved difficult to gain access to the necessary financial information. The majority of deviations between the estimated and recorded data fell within +/- 10%, indicating that the data collected by self-completion methods was sufficiently accurate for the purposes of the study.

Specification of dependent variables

Specification of dependent variables drew directly upon the hypotheses described in section 2. We first studied the 'local' economic integration of firms. To ensure comparability across the five countries given differences in settlement and transport patterns, and to take account of potential linkages between town and hinterland economies, dependent variables were specified in terms of the mean proportions of transactions (by financial value) attributed to zones A + B (*i.e.* the town + the 7km hinterland around the town). Separate variables were created to measure the strength of local integration in terms of i) sales (downstream transactions) and ii) purchases (upstream transactions). The corresponding descriptive statistics are presented in Appendix B.

A further aim of the study was to differentiate between various patterns of spatial economic behaviours throughout the wider economy (*i.e.* local, regional, national and international) in order to help assess the relevance of the observed production linkages to local economic development in small towns' economies. This analysis was deemed important for two main reasons. First, it allowed identification of those characteristics and contextual factors associated with the potential to both generate external income and stimulate local multipliers through sourcing and employment. For this, we need to distinguish among the different combination of firm's spatial behaviours those combining local sales, purchases and employment (corresponding to 'non-basic' firms) and those combining local purchases and employment with extra-local sales. Thus, by considering the wider patterns of sales, purchases and employment simultaneously, the extent to which firms had the ability to generate *net income* in the local economy could be identified in terms of export base theory. Second, with the use of a further dependent variable determining the extent of 'local' economic integration, the analyses helped to validate the results obtained by local integration analysis. In other words it provided a further set of local integration coefficients that could be cross-checked against the OLS results.

This further dependent variable was derived from a factor and cluster analyses. Firms were clustered in seven categories according to the patterns and significance of economic transactions made in zones A, B and C ('local'), in zones D and E ('regional'), in zone F ('national'), and in zones G and H ('international'). Such characteristics of a firm's spatial behaviour drew upon the relationship between patterns of sales, purchases and employment linkages across the four categories of zones (See Appendix C for a detailed description of the relevant variables).

Independent variable specification

According to our hypotheses we constructed three sets of independent variables (See Appendix B for descriptive statistics about these variables). The first set described the main intrinsic characteristics of the firm. Besides the usual characteristics such as the plant type (independent, branch of national or international firm), the industrial sector to which the firm belonged (manufacturing, construction, consumer service and business services), the firm's size (measured in terms of its number of employees), or the age of the firm (in years), we introduced variables aiming to examine the role of the firm's technology. Our data allowed us to calculate: (i) the share of unskilled workers within the firm's workforce; (ii) the firm's labour productivity (through the difference between output sales and inputs purchases divided by the number of full-time employees); and (iii) the intensity in intermediate goods of the firm's technology (by dividing the total firm's purchases by its total sales). In addition, we introduced the 'indigeneity' of the firm's owner defined in relation to current place of residence and the zone from which the owner had moved during the last 5 years.

The second set of variables related to general characteristics of the local context. Thus, we controlled for the country (UK, France, Netherlands, Portugal and Poland) for the town size (small or medium-sized, as defined) and for the characteristics of the zone where the firm is located (peri-

urban, agricultural or tourism), in distinguishing between a location in the town centre (zone A) and a location in the hinterland (zone B).

Finally, we constructed four variables to evaluate the role of the local economic environment of the firm, in order to open the 'black box' of the local context in focusing on its potential interactions with the local markets. Thus, we explored the role of the relationships that could be developed between the firm (according to the characteristics of its own demand) and the local markets of final demand, intermediate goods and labour (according to their characteristics, mainly their size or their structure).

We first defined an index of local competition. This is constructed by comparing the individual firm's sales with the total sales of all the local surveyed firms, *i.e.* the local competitors of firm *i*. We estimated the weight of the firm *i* in the local output produced by firms belonging to the same sector *s*:

$$LCI_i^r = \frac{S_{i,s}^r}{\sum_i S_{i,s}^r}$$

where $S_{i,s}^r$ is the total sales of firm *i* located in study area *r* and belonging to sector *s*.[7]

Second, using data from both business and household surveys, we aimed to evaluate the size of the local final goods market facing individual firm *i*. For this, we calculated (through the household survey with adapted weighting[8]) the local demand addressed by all local households *j* to sector *s* (the sector at which individual firm *i* belongs) and compared this to the sales of individual firm *i*. The corresponding index is thus defined as:

$$SLFGM_i^r = \frac{\sum_j HhP_{j,s}^r}{S_{i,s}^r}$$

where $HhP^{r}_{j,s}$ are the local purchases made by households *j* living in study area *r* to firms belonging to sector *s*, and $S^{r}_{i,s}$ is the sales of individual firm *i* located in study area *r* and belonging to sector *s*.

Third, we tried to capture the role of local supply of intermediate goods relative to a firm's demand on its spatial behaviour. For this, we compared the firm's demand for intermediate goods (*i.e.* purchases of all types of intermediate across all locations) to the local production of those intermediate goods (*i.e.* the total sales by local suppliers of these goods). The corresponding index aims to measure the potential intensity of local backward linkages. It is computed as follows:

$$IPBL^{r}_{i} = 100.\left[\sum_{s'} \frac{P^{r}_{i,s'}}{\sum_{s'} P^{r}_{i,s'}}.\left(\frac{P^{r}_{i,s'}}{\sum_{s'} P^{r}_{i,s'}} - \frac{\sum_{i} S^{r}_{i,s'}}{\sum_{s'}\sum_{i} S^{r}_{i,s'}}\right)\right]$$

where $P^{r}_{i,s'}$ is the total purchases made in sector *s'* by firm *i* located in study area *r* and $S^{r}_{i,s'}$ the total sales of all firms located in study area *r* and producing goods *s'*. Thus, for each type of intermediate good used by the firm *i*, we compare the structure of the firm's demand for these goods to the local supply of these intermediate goods. Then, we sum all these differences and weight them according to the mix of intermediate goods that the firm demands. When it is higher than 0, the firm's demand for inputs exceeds the level of local supply of these inputs, thus the firm needs to source its inputs from outside the study area. When it is equal to or lower than 0, the firm's demand for inputs can be met locally.[9]

Fourthly, in the same way as the previous index (potential intensity of local backward linkages), an index of potential skill matching in the local labour market was developed. This compares the share of a firm's demand for skilled labour to local supply of skilled labour. It is defined as:

$$LLM^{r}_{i} = 100.\left(\frac{SkiLD^{r}_{i}}{LD^{r}_{i}} - \frac{\sum_{j} SkiLHhS^{r}_{j}}{\sum_{j} LHhS^{r}_{j}}\right)$$

where $SkiLD_i^r$ is the demand for skilled workers by firm i located in study area r, LD_i^r is the demand for all workers by firm i, $SkiLHhS_j^r$ is the number of skilled workers in households j living in study area r and $LHhS_j^r$ is the total number of workers in households j living in study area r. When the index is close to -100, the supply of skilled labour in the local labour market could meet the firm's level of demand for skilled labour if all local firms have an equivalent demand. When the index is close to +100, the firm's demand for skilled labour exceeds the supply of skilled workers in the local labour market. When the index is close to zero, there is a potential balance between the levels of local supply and a firm's demand for skilled (and unskilled) labour.

Econometric issues

Two phases of multivariate analysis were undertaken: 1) A series of Ordinary Least Squares (OLS) Regressions to examine the key characteristics of entity and local environment associated with strong local economic integration; and 2) A multinomial logit model, to identify the key characteristics associated with the various patterns of spatial behaviour throughout the local, regional, national and international economy.

Ordinary Least Squares (OLS) Regression was employed to help identify key characteristics of towns, firms and attributes of the economic environment associated with strong local economic integration. The basic model can be expressed as:

$$y_i = X_i\beta + \upsilon_i$$

where i = 1, ... n, represents the number of firms in the model (also serving as number of observations), y_i = is the respective dependent variable (as set out in Table 1), X_i = is a vector of independent variables representing the relevant entity characteristics, β is a vector of parameters to be estimated, u_i is an independently distributed error term assumed to be normal with zero mean and

constant variance σ^2. The advice of HAIR *et al.*, 1998, and GUJARATI, 2003, was taken with regard to meeting and testing the suitability of data for multiple regressions, including examination of residual and normal probability plots and carrying out data transformations as appropriate[10].

When we focused on the characteristics of entity and local environment associated with the various forms of spatial economic behaviour identified by the factor and cluster analyses (presented in Appendix C), the nature of the dependent variable did not allow use of the OLS method. The variable is now categorical because it is based on the groups derived from the cluster analysis. Furthermore, the derived variables suggest that firms exhibit multiple combinations of spatial economic behaviour, or in other words face multiple 'choices' with regard the spatial distribution of their transactions. For example, a firm's spatial behaviour can be wholly local, partially local (i.e. combining local sales or purchases with regional, national and/or international transactions), regional, national or international. Because this multiplicity in the variable is unordered, it is appropriate to use a multinomial logit model, which can be expressed as (GREENE, 1997):

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j x_i}}{\sum_{k=1}^{J} e^{\beta_k x_i}} \qquad \text{for } j = 1, 2, \ldots, J,$$

where Y_i is a random variable that indicates the 'choice' made by firm i, j *is* the 'choice' made by the firm J is the total number of possible choices, x_i the characteristics of firm i that affect the choice (including study area characteristics), and β_j the parameter to be estimated. Estimation of the multinomial logit model requires using the Maximum Likelihood method.

EMPIRICAL RESULTS AND RELATED DISCUSSION

Factors influencing the firm's downstream and upstream local integration

A series of OLS models were estimated with the proportion of i) sales and ii) purchases attributed to zones A and B as dependent variables. In each case, three sets of explanatory variables were progressively introduced. Models (1) focus only on the organisational and technological characteristics of firms; models (2) add local context variables, while models (3) investigate further the role of local contexts by adding variables that correspond to potential linkages that firms have with local markets. All OLS results are given in Table 1.

In terms of the explanatory power of the models, there are two main points to note. First, the models indicate that the included predictors more readily explain the strength of local downstream (sales) integration compared to upstream (purchases) integration. The R-square values vary from 0.167 to 0.270 for the former and 0.107 to 0.188 for the latter. Second, the introduction of the local context variables significantly improves the explanatory power of both models while further inclusion of variables relating the local economic environment has only a marginal influence over the R-square values.

[Table 1 here]

The above results confirm those of previous studies with respect to the influence of organisational characteristics on local integration. As found by WILLIAMS, 1994, and CURRAN and BLACKBURN, 1994, the manufacturing, producer services and construction sectors are found to exhibit relatively weak local downstream linkages. However, only the manufacturing sector also buys less locally than the reference ('other services') whereas producer services and the construction sector both exhibit significantly stronger upstream linkages. These findings would

indicate that producer services and the construction sector are potentially important generators of 'net income' through their propensity to source locally while serving external markets.

WILLIAMS, 1994; CURRAN and BLACKBURN, 1994, and COURTNEY and ERRINGTON's, 2000, findings that shops and consumer services tend to sell more locally are not strongly confirmed by the analysis, although this may be due to the comparison made with 'other services'. In contrast to the findings of WILLIAMS (1994), our analyses also reveals that shops and consumer services tend to purchase their inputs from markets outside the local area.

Other organisational characteristics examined include firm ownership, age, size and other technological characteristics (including productivity). In accordance with the findings of CURRAN and BLACKBURN, 1994, ERRINGTON, 1994, and HARRISON, 1993, smaller firms are found to sell more locally, likewise with the findings of COURTNEY and ERRINGTON, 2000, and HARRISON, 1993, they also tend to purchase their intermediate goods more locally compared to larger firms. With respect to firm age, however, the findings refute those of CURRAN and BLACKBURN, 1994, and NORTH and SMALLBONE, 1996, who assert that newly established firms turn to local markets in their initial stages of operation. Indeed, in our case, older firms are found to sell a greater proportion of their outputs in local markets while there is no significant influence of firm age on the level of upstream integration.

In a similar way, parameter estimates for technological characteristics show that firms with a high level of unskilled workers in the workforce or those with lower levels of labour productivity tend to be more locally oriented in terms of sales markets. There is, however, no significant influence of both of these characteristics on local upstream integration. Logically, a higher intensity in intermediate goods within the firm's technological process reduces the degree of local upstream integration but has no significant influence over the degree of local sales integration. Examining the

influence of firm ownership, the present findings do not wholly support those of COURTNEY and ERRINGTON, 2000, GRPAIOS *et al.,* 1989, and DOBSON, 1985, who found that branch plants tend to be less tied to locality than independent firms. Parameter estimates indicate that national branches exhibit relatively strong linkages to small town economies, although branches of international companies tend to make extra-local purchases to a greater extent than independent firms or national branch plants. Taken together, these results tend to show that it is the more traditional firm (i.e. those which are smaller, older, have lower levels of labour productivity and employ a higher proportion of unskilled workers) that is more strongly integrated into its locality, especially in terms of local sourcing patterns.

The present findings serve to reinforce and build on those of MILLS, 2002, with respect to the influence of indigeneity on local sales and purchases. This characteristic is found to have an influence on spatial patterns of sourcing in terms of length of time an owner/manager has lived in an area. Owner/managers who have lived in the local area for more than ten years tend both to source more of their intermediate goods locally and to sell more of their outputs locally. Indeed, the reasons for the observed patterns may well be associated with the strength of social networks and the importance of embeddedness (GRANOVETTER, 1985) in business decision-making.

The addition of contextual factors in the two sets of integration models reveals some interesting results with respect to both first round linkages and rural development. The nature and strength of local production linkages is found to vary according to study area type, town size and location within the study areas. This would imply that all towns are to an extent unique, each with their own set of circumstances that will affect the functioning of the local economy. First, firms located in a medium-sized town study area sell their outputs and buy their inputs more locally than those located in a smaller town study area, indicating that the size of local markets may play an influential role in the degree to which a firm is locally integrated. Second, firms located within the town are more

strongly integrated into local sales markets than those in the hinterland, which mirrors the findings of COURTNEY and ERRINGTON, 2000, and MITCHELL *et al.,* 2005 with respect to small town economies in England and Scotland respectively. There is, however, no difference between town and hinterland firms in terms of the degree of local sourcing, which may be a consideration for planners wishing to stimulate rural and town development through local output multipliers. While containment of development in towns may help preserve the open countryside it may not necessarily help foster higher levels of economic growth than more dispersed development in the hinterland of towns. Third, firms located in agricultural study areas are more locally oriented in terms of sales and purchases than those located in peri-urban areas or even areas where employment in tourism is above the national average. Arguably the most important differences highlighted by the models are those between towns in different parts of Europe. Compared to those in France (the reference), firms in Portuguese and Polish towns are more strongly integrated in terms of both sales and purchases. Estimates for the UK and the Netherlands show weaker levels of sales integration relative to French firms, although no difference is evident between the three countries with respect to upstream linkages, highlighting clear differences between the role of towns in Portugal and Poland and the other three countries.

Drawing on concepts of the economic geography, our approach paid special attention to the firm's local economic environment and associated characteristics in terms of a locale's ability to satisfy the demand from local firms. These variables are added to the third set of models. The marginal change in R^2 values as a result of their inclusion (from .265 to .27), and the parameter estimates themselves, indicate that, with respect to rural firms, these characteristics are not influential predictors of local economic integration. The only significant characteristic is the potential intensity of local backward linkages, with negative parameters indicating that firms where the demand for intermediate goods can be met by local supply, have relatively high levels of local upstream, and even downstream, integration. In other words, stronger potential local backward linkages tend to

favour a stronger level of local economic integration by rural firms. This finding is consistent with those obtained by AMITI and CAMERON, 2004, MION, 2004a, or GAIGNE *et al.,* 2003, who highlight the positive role of vertical linkages in industrial location processes. The influence of other economic characteristics of local markets is less certain. It seems, however, that stronger levels of competition in the local output market disfavours local downstream integration (as one might expect) while a larger local final goods market, surprisingly, favours local sourcing of intermediate goods.

Finally, our results show that the relative size of the local final demand market and the labour market have no significant effect over levels of local economic integration. While this may represent an important distinction between rural firms and their urban counterparts, it is worth noting that the role of final market demand in the location process is itself controversial. For example, HANSON, 1998, and MION, 2004a, showed a positive effect of the local final demand market, GAIGNE *et al.*, 2003 found that local final demand had no significant effect on industrial location, and MION, 2004b, found a negative relationship between the two. Empirical studies analysing the role of labour market on the location processes are in fact rare. GAIGNE *et al.,* 2003, showed that the labour market played an ambiguous role in firm location, and that the extent of its influence varied between sectors.

Factors influencing the firm's spatial behaviour

To complete the analysis of local upstream and downstream integration and its determinants, a multinomial logit analysis was carried out, with dependent variables based on four groups of spatial behaviour derived from a factor and cluster analysis (See Appendix C). The logit analysis provides an additional contribution to the literature on local first round linkages in considering integration into the regional, national and international economies. It also explores the relationships between upstream, downstream and employment linkages, which is especially useful in identifying

characteristics with potential for generating net income in the local economy. Results of the multinomial logit analysis are given in Table 2. While these results nearly always confirm the results obtained by the OLS regressions focusing on the predictors of local integration, they also allow us to identify the factors associated with wider forms of spatial economic behaviour.

We firstly describe the groups obtained through the factor and cluster analyses, which are in turn used to derive dependent variables for the logit analysis. In particular, it is worth noting the extent to which local linkages feature among the derived classifications of spatial economic behaviour. A total of 816 surveyed firms (30%) exhibit a high propensity to simultaneously sell, source and employ locally. Expressed in terms of export base theory, they represent 'non-basic' firms. In contrast, only a handful of firms correspond to the 'net income' sector: 169 firms (6% of those surveyed) reach out to external markets for sales while utilising local markets for input sourcing and employment. A large proportion of firms, however, exhibit the opposite behaviour: 603 firms (22%) combine local sales and employment with regional outsourcing, while 437 firms (15%) combine local sales and employment with national outsourcing. And, a large proportion of the sample (22%) adopts wholly external economic behaviours with respect to both sales and purchases: 221 of such firms sell and source in the regional economy and 265 operate more often at the international level. Both of the above categories employ predominantly local workers while only 177 firms source employees from regional labour markets (see Table C.2 in Appendix C).

[Table 2 here]

As the parameter estimates in Table 2 indicate, industrial sector plays an important role in a firm's spatial behaviour. Manufacturing firms are more often connected to the wider economy; their purchases come frequently from regional input markets, they often sell their outputs in the regional or international economy and their workforce is often recruited at the regional level. The logit

analysis thus confirms the limited potential of the manufacturing sector to stimulate rural development through local multipliers. While the OLS models showed that firms belonging to construction or producer services sectors exhibit strong linkages to local input markets, this 'net income' role of the construction sector is not so evident from the logit analysis and producer services are found to reach out to non-local markets in terms of sales.

Shops and consumer services, while selling locally and employing local labour, tend to purchase their inputs from regional, or even national, markets, most likely because they are tied into organisational sourcing strategies. This refutes WILLIAMS', 1994; 1997, assertion that, while consumer services may not provide a significant injection of income through export activities, they do help generate *net income* (which is determined by total external income, times a multiplier, minus total external spending) through their propensity to source locally. Of course, local employment will also help foster induced effects if wages are spent locally.

Compared to independent firms (the large majority in the sample), national branch plants tend to exhibit a nationally orientated purchasing behaviour. Local branches of international firms tend to access international output and input markets and to make greater use of regional or national input markets. However, of particular importance is the finding that branches of national and international companies often adopt a 'net income' behaviour, combining local purchases and employment with national sales. Firm size is found to influence spatial patterns of economic behaviour in a similar way. While previous results have shown a negative correlation between workforce size and the strength of local upstream and downstream integration, further analysis of our data reveals that smaller firms exhibit wholly local behaviours. Parameter estimates indicate that larger firms are more likely to adopt 'net income' behaviours (combining local purchases and employment with national sales) or wholly external behaviours.

In the same way, while results of the OLS models have revealed an association between low labour productivity and strong local integration in terms of sales and purchases, the multinomial logit analysis indicates that firms with higher labour productivity tend to purchase their inputs on national markets or to adopt an external behaviour in terms of both sales and purchases. Consistent with previous results, firm intensity in intermediate goods tends to favour regional and national purchasing behaviours as well as regional and international behaviours in terms of both sales and purchases; as one might expect it does not favour national sales combined with local sourcing of inputs and labour. Finally, the adoption of 'net income' behaviour is favoured by firms which have a higher proportion of skilled workers in their workforce. Thus, as firm size, labour productivity and the level of intensity in intermediate goods increases, firms appear more likely to adopt non-local economic behavioural patterns. These findings imply that the largest, most productive and most intensive firms have the least potential to stimulate rural development through local multipliers.

While firm age plays a relatively weak role in explaining spatial behaviour (although the results do suggest that recently established firms tend to adopt a more international behaviour), indigeneity of the owner/manager does have an influence. Firms managed by residents who have lived in the study area for ten years or more are found to be more locally oriented in terms of sales, purchases and employment. Interestingly, those managed by residents who have moved into the study area within the last ten years are less likely to adopt 'net income' behaviour in comparison to all other patterns of behaviour. One possible explanation is that, while in-migrants may tap into local markets for sales and labour, they continue to use suppliers or business services (*i.e.* accountants) which are based in their previous location, for a period of time at least. Indeed, similar behavioural patterns were also observed by MILLS, 2002, in his study of rural producer services in England.

Examining the role of local contextual factors, it appears that the size and the type of the study area town do influence a firms' wider spatial behaviour. Firms located in medium-sized towns are less

often orientated towards national or international input markets. Firms in tourism study areas are more internationally oriented in terms of sales and purchases, while those located in peri-urban areas are more often locally integrated in terms of purchases. Proximity to urban areas allows access to larger markets, likewise it follows that firms located in tourism areas are more able to develop links with international markets. Compared to French firms located in small and medium-sized towns and their hinterland, Portuguese and Polish firms are more locally integrated in terms of sales, purchases and employment. The logit analysis also shows that firms in English and Dutch towns are more likely to source inputs from beyond the region. In fact, Dutch firms appear to be more internationally integrated, which is most likely attributed to their historical development.

The results of the multinomial logit analysis provide further evidence that size of the local final demand market and the characteristics of the labour market in terms of skill level have no significant influence on the spatial economic behaviour, *i.e.* on the spatial combination of firm sales, purchases and employment. Indeed, no significant parameter value is obtained for the local final market size (the ratio of the firm's output compared to the magnitude of local household demand) and for the potential skill matching in the local labour market (the gap between a firm's demand for skilled labour and corresponding supply in the local labour market.). The influence of the local competition index (the ratio of a firm's sales compared to those of its local competitors) is, however, a little more marked. Parameter estimates indicate that fiercer local competition tends to favour patterns of national purchasing combined with local sales and labour, as well as wholly external behaviours.

The only economic environment parameter that has a clear effect on spatial economic behaviour is the ratio between the demand for inputs and the local supply of such inputs. Parameter estimates indicate that the greater the gap between the local supply of, and demand for, intermediate goods, the more likely it is that all types of transaction will be non-local. Thus, when local input markets

are relatively small and firms have a high demand for particular inputs, they tend to seek them on non-local markets. Conversely, when the local supply of required intermediate goods is close to the level of firm's demand, firms tend to purchase their intermediate goods locally. However, this factor doesn't distinguish 'net income' behaviour from other extra-local behaviours. Interestingly, there appears to be a relationship between input and output markets at the local level; local integration through intensive local backward linkages, in turn has a positive effect on local sales behaviour.

CONCLUSIONS

This paper has examined the spatial patterns of economic transactions of firms located in and around small and medium-sized towns across five European countries, drawing on theoretical aspects of local economic development, empirical evidence from previous studies of rural linkages and concepts from the economic geography to help develop useful hypotheses to test. These hypotheses fall into three broad categories: organisational characteristics, local contextual characteristics and characteristics of the potential links between the firm and local markets. Two types of analyses were offered. In the first, we examined the role of these factors on the local integration of the firm's sales and purchases. In the second, we combined the spatial patterns of sales, purchases and employment in order to define firms' spatial behaviours in relation to the ability to simultaneously generate external income and stimulate local multipliers. We then analysed how these patterns of behaviour were influenced by the above characteristics.

With respect to organisational characteristics, consumer services are not found to exhibit relatively strong levels of local integration; the construction sector and producer services do have strong local ties, but only to input markets. However, the analysis of spatial behaviours indicates that these sectors are not strong generators of 'net income'. While independent firms are not found to be more locally integrated than externally owned establishments, the findings support the hypothesis that

owner managers who are 'local' to the area tend to source more locally than in-migrants, they are also found to be more locally integrated in terms of sales. In addition, branches of national or international firms, as well as firms managed by external owners, adopt a stronger 'net income' behaviour, that is they tend to purchase their required inputs (intermediate goods and employment) locally and sell their outputs in the national economy. Supporting the findings of previous studies, small firms are found to both source and sell locally, although in this case it is older (as opposed to newly established) firms which are more integrated into local sales markets, with no significant difference observed in terms of upstream integration.

With respect to local contextual characteristics, firms in town locations are found to sell more locally than those in the hinterland of towns, although this finding is not extended to patterns of input sourcing. Findings do, however, support hypotheses with respect to town size and area type. Larger towns have more self-contained local economies than smaller towns, and towns in agricultural areas are more locally integrated in terms of production linkages than those in peri-urban or tourism areas, although the latter areas do not enjoy a strong degree of local upstream integration. As expected, less productive firms, and those employing a greater proportion of unskilled labour are more integrated into local sales markets. Likewise, firms which spend a greater proportion of their turnover on inputs tend to source more of them locally.

The economic geography framework suggested a number of useful hypotheses to test with regard to the potential links between the firm and local markets. Contrary to expectation, the relationship between rural firms and size of local final demand and labour markets do not strongly influence the degree to which firms operate locally, although a relationship is observed between the magnitude of local final demand and the propensity to source locally. The hypothesis that weaker levels of local competition is associated with stronger levels of downstream integration is upheld, likewise the size

of local markets for intermediate goods is found to positively influence the strength of local upstream linkages.

As well as testing these hypotheses, the analysis has built on the existing evidence base by examining wider patterns of spatial economic behaviour, the nature of relationships between different types of linkages, and of course the variation between different European countries. Focusing on the implications of the findings for rural development, three main conclusions can be drawn.

First, the importance of local context highlighted by the findings should not be under-estimated. While an attempt has been made here to identify patterns emerging from analyses of production linkages in thirty towns across Europe, it is clear that local economic activity will (in part) be shaped by local factors, some of which may be outside the control of planners and policy makers. Towns in Portugal and Poland exhibit considerably stronger linkages than in the other three countries studied and a higher degree of economic self-containment is evident in 'medium-sized' (pop. 15-20,000) as opposed to 'small' (pop. 5-10,000) towns, and in study areas where employment in agriculture is above the national average. Although the present study did not aim to specifically examine the strength of town-hinterland linkages, locational differences do indicate that the containment of development in towns may not necessarily help foster higher levels of economic growth than more dispersed development in the hinterland of towns.

Second, the findings suggest that those firms which exhibit the strongest degree of integration into their locality are 'traditional' rural firms broadly characterised by being small, old, run by local managers, employing unskilled labour and achieving relatively low levels of productivity. In effect, this represents a double-edged sword for policy makers wishing to foster economic growth in small towns and stimulate surrounding rural economies. While 'traditional' rural firms may have stronger

local linkages, and in turn help generate growth through multipliers, they may not have the capacity to benefit rural development or growth in the longer term. Conversely, while more technological firms may possess the required capacity to help foster local economic growth (at least through their ability to inject income into the economy), their inability to generate growth and development through local output multipliers is potentially limited.

That said, the findings do provide insights into how small town economies could be developed through fostering local linkages, and this study has paid particular attention to those firms with the potential to generate 'net income' in the local economy (determined by total external income, times a multiplier minus total external spending.). This leads onto the third conclusion, which is that only a handful of rural firms are found to exhibit 'net income' behavioural traits and that these firms are themselves not readily differentiated. In terms of sector, only producer services are found to combine local sourcing of inputs and labour with extra-local sales, and findings of the logit analyses suggest that branches of national and international companies, and larger firms, are more likely to have the potential to generate net income in the local economy of small towns. Examination of economic behavioural patterns helps explain this. While a third of all firms surveyed exhibit economic self-containment behaviour, or at least sell and source their labour locally, the majority of firms do not source inputs from within the locality. Even retail and consumer services, which are arguably the mainstay of a sustainable economy in small towns, are found largely to source inputs from outside the area. Therefore, local sourcing strategies deserve particular attention by policy makers concerned with the growth and development of these settlements.

APPENDICES

Appendix A: Selected case study areas and number of firms by study area

Number of surveyed firms (N_a) & weighted number of firms (N_w)

Type of Area	Small Town	Medium-sized Town
Agricultural	Brioude (FR) (N_a=67; N_w =94) Leominster (UK) (N_a=40; N_w =53) Dalfsen (NL) (N_a=77; N_w =72) Glogówek (PL) (N_a=129; N_w =91) Mirandela (PT) (N_a=128; N_w =147)	Mayenne (FR) (N_a=59; N_w =88) Tiverton (UK) (N_a=34; N_w =48) Schagen (NL) (N_a=90; N_w =79) Jędrzejów (PL) (N_a=127; N_w =131) Vila Real (PT) (N_a=131; N_w =150)
Tourism	Prades (FR) (N_a=62; N_w =96) Swanage (UK) (N_a=32; N_w =46) Bolsward (NL) (N_a=91; N_w =71) Duzniki (PL) (N_a=94; N_w =79) Tavira (PT) (N_a=147; N_w =147)	Douarnenez (FR) (N_a=65; N_w =99) Burnham-on-Sea (UK) (N_a=35; N_w =52) Nunspeet (NL) (N_a=99; N_w =85) Ultsroń (PL) (N_a=122; N_w =138) Silves (PT) (N_a=151; N_w =150)
Periurban	Magny-en-Vexin (FR) (N_a=52; N_w =78) Towcester (UK) (N_a=39; N_w =63) Oudewater (NL) (N_a=80; N_w =64) Ożarów (PL) (N_a=135; N_w =198) Lixa (PT) (N_a=148; N_w =148)	Ballancourt-sur-Essonne (FR) (N_a=40; N_w =65) Saffron Walden (UK) (N_a=47; N_w =43) Gemert (NL) (N_a=95; N_w =75) Lask (PL) (N_a=123; N_w =147) Esposende (PT) (N_a=149; N_w =148)

Appendix B: Some descriptive statistics about surveyed firms

N, Mean and Standard Deviation (as appropriate)

	France	UK	NL	Poland	Portugal	All 30 study areas
Number of firms	520	305	446	784	890	2945
Sales (A+B)	53.74	43.79	36.43	70.99	64.34	57.88
	(48.84)	(48.09)	(34.15)	(40.79)	(36.25)	(42.01)
Purchases (A+B)	25.06	19.00	23.40	35.03	34.13	29.58
	(37.57)	(32.89)	(28.95)	(36.08)	(38.16)	(35.93)
Manufacturing sectors	53	53	36	83	116	341
Construction	68	35	61	58	87	309
Shops and consumer services	166	112	188	421	470	1357
Producer services	103	62	126	159	99	549
Other services	130	43	35	63	118	389
Independent firms	387	255	421	691	794	2548
Branch of a national firm	110	31	14	52	51	258
Branch of a international company	23	19	11	41	45	139
Lived in zones A or B for 10 years or more	330	166	316	633	693	2138
Moved to zones A or B from C or D in last 10 years	49	22	12	27	29	139
Moved to zones A or B from E or H in last 10 years	42	45	45	14	51	197
Never lived in zones A or B	99	72	73	110	117	471
Age of firm (in years)	45.9	38.0	58.8	9.7	14.7	27.7
	(210.3)	(164.2)	(182.1)	(12.0)	(15.8)	(116.6)
Size of workforce (number of employees)	5.59	6.32	6.63	7.09	8.09	6.64
	(18.46)	(18.41)	(20.20)	(30.04)	(24.85)	(24.75)
Proportion of unskilled workers (%)	23.49	22.65	17.36	3.34	17.37	15.26
	(35.37)	(35.45)	(26.62)	(11.26)	(25.93)	(26.77)
Index of intensity of intermediate goods	46.38	53.46	52.56	64.22	56.70	55.92
	(32.27)	(30.60)	(26.12)	(24.20)	(26.18)	(27.64)
Labour productivity	41.98	40.51	65.51	23.41	39.29	39.64
	(54.20)	(63.75)	(181.00)	(377.95)	(250.40)	(256.98)
Local competition index	16.96	21.85	11.57	17.81	10.10	14.80
	(30.22)	(36.86)	(19.74)	(27.56)	(20.87)	(25.90)
Index of size of local final goods market	67.41	55.59	24.21	5.38	28.49	31.37
	(535.43)	(394.96)	(123.79)	(19.89)	(137.38)	(243.88)
Index of potential local backward linkages	46.48	49.38	56.30	43.55	49.24	48.33
	(37.07)	(32.44)	(30.18)	(27.21)	(32.16)	(31.50)
Potential skilled matching on local labour market	-0.73	-1.75	13.88	54.31	10.05	19.28
	(40.66)	(43.99)	(36.54)	(29.76)	(35.71)	(42.44)

Standard deviation in brackets

Appendix C: Factor and cluster analyses for defining firm spatial behaviours

In order to determine the spatial behaviours of firms we first defined four levels of location for their sales, purchases and labour recruitment areas: local (which includes zones A, B & C), regional (zones D & E), national (zone F) and international (zones G & H). Because we put together national and international labour recruitment areas in one category, we then obtained eleven categories for describing the spatial behaviour of each firm. We introduced them in a Principal Component Analysis (PCA), which also included surveyed farms. The main factors resulting from this PCA were then used in a hierarchical cluster analysis to identify the main spatial behaviours of firms (and farms). Table C.1 contains the results of the PCA.

[Table C.1 here]

The first five factors explain 75% of the variance in the data set. The first factor, which explains 24% of the total variance, is characterised by a correlation between local sales and local employment as opposed to regional employment. Factor 2, which explains 15% of the total information, captures another type of firm, characterised by local sales and regional (as opposed to local) employment. Factor 3, which explains 14% of the variance, focuses on purchasing activity. Firms scoring highly on this factor would tend to source a relatively high proportion of their inputs locally, as opposed to elsewhere in the region. Factor 4 shows an inverse correlation between national purchasing and regional sales. Finally, Factor 5 tends to isolate firms with a strong level of international integration.

The hierarchical cluster analysis based on these five main factors allowed us to identify seven groups of firms (and farms) according to the spatial pattern of their sales, purchases and workforce living place. Table C.2 summarises the average characteristics in terms of spatial patterns for each group.

[Table C.2 here]

Firms in group I have a local behaviour in terms of sales, purchases and employment while firms in group II differ by having more regional purchases. Firms in group III have a regional behaviour (except in terms of employment), while firms in group IV combine national purchases with local sales and employment. Firms in group V exhibit an inverse behavioural pattern by combining national sales with local purchases and employment. Group VI comprises internationally integrated firms with international sales and purchases, whilst retaining local employment. Finally, group VII groups firms that are sourcing a significant part of their workforce from the regional labour market.

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Spatial patterns of production linkages in the context of Europe's small towns: How are rural firms linked to the local economy?

Tables

Table 1. Results for local integration of firm's sales and purchases

(dependant variable: proportion of firm's sales and purchases made in zones A and B, OLS)

	i) Sales (A+B)			ii) Purchases (A+B)		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
Intercept	57.82***	58.32***	61.19***	39.46***	35.83***	41.64***
	(3.28)	(3.60)	(3.72)	(2.91)	(3.30)	(3.35)
Firm sector (reference: 'Other services')						
Manufacturing sectors	-24.23***	-23.02***	-20.32***	-12.11***	-11.36***	-7.83***
	(3.05)	(2.89)	(2.95)	(2.70)	(2.64)	(2.66)
Construction	-14.56***	-9.73***	-8.72***	2.02	4.46*	6.82**
	(3.04)	(2.87)	(2.96)	(2.69)	(2.63)	(2.67)
Shops and consumer services	3.96*	1.76	2.74	-8.99***	-10.24***	-6.45***
	(2.33)	(2.22)	(2.30)	(2.07)	(2.03)	(2.07)
Producer services	-20.36***	-17.33***	-17.03***	4.40**	6.04***	7.34***
	(2.61)	(2.49)	(2.51)	(2.31)	(2.28)	(2.26)
Type of ownership (reference: Independent firms)						
Branch of a national firm	6.16**	4.32*	4.21*	-2.29	-1.41	-1.37
	(2.63)	(2.51)	(2.51)	(2.33)	(2.30)	(2.26)
Branch of a international company	2.85	-1.58	1.77	-7.25**	-7.34**	-6.37**
	(3.43)	(3.23)	(3.22)	(3.04)	(2.95)	(2.91)
Age of firm (years in ln)	1.80***	3.42***	3.39***	-1.13**	-0.29	-0.35
	(0.61)	(0.58)	(0.58)	(0.54)	(0.53)	(0.52)
Size of workforce (number of employees, ln)	-6.24***	-7.38***	-6.63**	-2.36***	-3.06***	-3.24***
	(0.74)	(0.70)	(0.77)	(0.65)	(0.64)	(0.70)

Table 1. Results for local integration of firm's sales and purchases

(Continued)

	i) Sales			ii) Purchases		
	(A+B)	(A+B)	(A+B)	(A+B)	(A+B)	(A+B)
Proportion of unskilled workers (%)	0.03	0.14***	0.15***	-0.03	0.04	0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Index of intensity of intermediate goods	-0.02	-0.02	-0.009	-0.16***	-0.19***	-0.18***
	(0.03)	(0.03)	(0.028)	(0.03)	(0.02)	(0.03)
Labour productivity	-0.011***	-0.010***	-0.009***	-0.006**	-0.005*	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Indegeneity of firm's owner (reference: Never lived in zones A or B)						
Lived in zones A or B for 10 years or more	9.96***	5.73***	5.61***	12.87***	9.07***	8.86***
	(2.04)	(1.95)	(1.95)	(1.81)	(1.79)	(1.75)
Moved to zones A or B from C or D in last 10 years	0.49	0.95	0.81	-0.89	-0.15	0.55
	(3.75)	(3.54)	(3.53)	(3.32)	(3.23)	(3.18)
Moved to zones A or B from E or H in last 10 years	-5.93*	-1.78	-2.62	5.75*	7.04**	5.86**
	(3.30)	(3.13)	(3.12)	(2.92)	(2.86)	(2.82)
Town size (reference: Small towns)						
Medium-sized towns		3.81***	3.86***		4.10***	4.18***
		(1.34)	(1.33)		(1.22)	(1.21)
Type of study area (reference: Agricultural study areas)						
Tourism study areas		-4.85***	-4.54***		-5.05***	-4.03***
		(1.66)	(1.66)		(1.51)	(1.49)
Periurban study areas		-6.71***	-6.30***		-8.32***	-6.55***
		(1.65)	(1.67)		(1.51)	(1.51)

Table 1. Results for local integration of firm's sales and purchases

(Continued)

	i) Sales			ii) Purchases		
	(A+B)	**(A+B)**	**(A+B)**	**(A+B)**	**(A+B)**	**(A+B)**
Country (reference: France)						
United Kingdom		-5.109**	-4.87*		-1.98	-1.68
		(2.64)	(2.63)		(2.41)	(2.37)
Netherlands		-12.31***	-12.50***		-0.74	0.96
		(2.42)	(2.45)		(2.21)	(2.21)
Poland		20.92***	18.80***		15.91***	15.32***
		(2.28)	(2.53)		(2.09)	(2.29)
Portugal		10.83***	9.84***		13.83***	13.68***
		(2.10	(2.13)		(1.92)	(1.92)
Location (reference: zone A)						
Location - zone B		-9.88***	-9.85***		0.40	-0.69
		(1.41)	(1.41)		(1.29)	(1.27)
Local competition index			0.075**			0.035**
			(0.002)			(0.028)
Index of size of local final			0.002			0.007**
goods market			(0.002)			(0.003)
Index of potential local			-0.084***			-0.196***
backward linkages			(0.023)			(0.021)
Potential skilled matching on			0.033			-0.016
local labour market			(0.022)			(0.021)
Adj. R^2	0.167	0.265	0.270	0.107	0.159	0.188
F-value	39.33***	44.94***	39.16***	24.09***	24.10***	24.91***
Residual *d.f*	2673	2665	2661	2673	2665	2661

Standard deviation in brackets;

*** sig. at 1 percent level (p<0.01) ** sig. at 5 percent level (p<0.05) * sig. at 1 percent level (p<0.1)

Table 2. Results of logit multinomial model for analysis of firm's spatial behaviour

(dependent variable: firm's spatial behaviour, ML)

	Local behaviour	Local sales (& empl) + regional purchases	Local sales (& empl) + national purchases	Local purchases (& empl) + national sales	Other behaviours (regional or international)
Intercept	Ref	-0.256	-0.671*	-0.453	-0.185
		(0.342)	(0.382)	(0.510)	(0.357)
Firm sector (reference: 'Other services')					
Manufacturing sectors	Ref	0.644**	0.364	0.520	1.651***
		(0.276)	(0.313)	(0.474)	(0.265)
Construction	Ref	-0.453*	-1.933***	-0.640	-0.207
		(0.244)	(0.366)	(0.406)	(0.234)
Shops and consumer services	Ref	0.448***	0.537***	0.023	0.408**
		(0.159)	(0.189)	(0.315)	(0.190)
Producer services	Ref	-0.573**	-0.745***	0.276	-0.550***
		(0.241)	(0.272)	(0.343)	(0.214)
Type of ownership (reference: Independent firms)					
Branch of national firms	Ref	0.410*	0.606**	1.027***	0.196
		(0.248)	(0.256)	(0.318)	(0.271)
Branch of international firms	Ref	0.318	0.486	0.915**	0.699**
		(0.334)	(0.364)	(0.404)	(0.309)
Age of firms	Ref	0.009	-0.054	-0.240***	-0.166***
		(0.052)	(0.057)	(0.083)	(0.047)
Size of workforce	Ref	0.152**	0.170**	0.596***	0.439***
		(0.078)	(0.085)	(0.105)	(0.067)

Table 2. Results of logit multinomial model for analysis of firm's spatial behaviour
(Continued)

	Local behaviour	Local sales (& empl) + regional purchases	Local sales (& empl) + national purchases	Local purchases (& empl) + national sales	Other behaviours (regional or international)
Proportion of unskilled workers	Ref	0.000	-0.002	-0.009**	-0.005*
		(0.003)	(0.003)	(0.004)	(0.003)
Intensity in intermediate goods	Ref	0.011***	0.011***	0.001	0.006**
		(0.003)	(0.003)	(0.004)	(0.002)
Labour productivity	Ref	0.001	0.003***	0.002	0.003***
		(0.001)	(0.001)	(0.002)	(0.001)
Indegeneity of firm's owner (reference: Never lived in zones A or B)					
Always lived in zone AB	Ref	-0.498***	-0.174	-2.323***	-0.586***
		(0.193)	(0.216)	(0.245)	(0.189)
Moved to AB from CD	Ref	-0.196	-0.033	-1.718***	-0.124
		(0.325)	(0.380)	(0.542)	(0.326)
Moved to AB from EH	Ref	-0.159	-0.144	-1.156***	0.211
		(0.333)	(0.363)	(0.398)	(0.296)
Town size (reference: Small towns)					
Medium-sized town	Ref	-0.039	-0.267**	-0.523**	-0.235**
		(0.115)	(0.132)	(0.204)	(0.119)
Type of study area (reference: Agricultural study areas)					
Tourism town	Ref	-0.147	-0.155	-0.234	0.264*
		(0.144)	(0.163)	(0.255)	(0.149)
Peri-urban town	Ref	-0.499***	-0.788***	-0.274	-0.024
		(0.148)	(0.171)	(0.238)	(0.150)

Table 2. Results of logit multinomial model for analysis of firm's spatial behaviour
(Continued)

	Local behaviour	Local sales (& empl) + regional purchases	Local sales (& empl) + national purchases	Local purchases (& empl) + national sales	Other behaviours (regional or international)
Country (reference: France)					
United Kingdom	Ref	-0.569*	-0.059	0.028	-0.026
		(0.309)	(0.311)	(0.386)	(0.272)
Netherlands	Ref	-1.219***	-0.029	0.335	-0.125
		(0.259)	(0.253)	(0.341)	(0.217)
Poland	Ref	-0.864***	-1.314***	-1.362***	-1.766***
		(0.247)	(0.275)	(0.410)	(0.246)
Portugal	Ref	-0.840***	-1.218***	-2.294***	-1.456***
		(0.209)	(0.149)	(0.378)	(0.223)
Location (reference: zone A)					
Location - zone B	Ref	-0.349***	-0.779***	-0.127	0.072
		(0.121)	(0.149)	(0.213)	(0.128)
Local competition index	Ref	0.004	0.011***	0.002	0.008**
		(0.004)	(0.004)	(0.005)	(0.003)
Index of final goods market size	Ref	0.000	0.000	-0.001	0.000
		(0.000)	(0.000)	(0.001)	(0.000)
Potential intensity of local	Ref	0.010***	0.016***	0.012***	0.009***
backward linkages		(0.002)	(0.002)	(0.003)	(0.002)
Potential skilled matching on	Ref	0.002	-0.001	0.000	0.002
local labour market		(0.002)	(0.002)	(0.003)	(0.002)
N	816	603	437	169	663
-Log L			3448		

Standard deviation in brackets;

*** sig. at 1 percent level (p<0.01); ** sig. at 5 percent level (p<0.05); * sig. at 1 percent level (p<0.1)

Table C.1. Results of the Principal Component Analysis of firm (& farm) spatial behaviours

EigenValue	1	2	3	4	5
Value	2.599	1.628	1.538	1.382	1.157
% variability	0.2363	0.1480	0.1398	0.1256	0.1052
% cumulate	0.2363	0.3842	0.5241	0.6497	0.7549
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Purchases in zones A, B or C	-0.45841	0.23077	0.76193	-0.35929	-0.09129
Purchases in zones D or E	-0.01788	-0.38233	-0.69156	-0.38395	0.29627
Purchases in zones F	0.38307	-0.01564	-0.22600	0.71031	-0.48552
Purchases in zones G or H	0.35656	0.23436	0.00631	0.19812	0.58396
Sales in zones A, B or C	-0.70916	-0.60171	0.12265	0.30862	0.09954
Sales in zones D or E	0.29780	0.24428	-0.32186	-0.63503	-0.35983
Sales in zones F	0.55837	0.43356	0.09645	0.10944	-0.12548
Sales in zones G or H	0.31333	0.34864	0.07304	0.11584	0.57345
Employees living in zones A, B or C	-0.74195	0.55613	-0.34679	0.13606	-0.00636
Employees living in zones D or C	0.64450	-0.55615	0.20054	-0.12433	0.00820
Employees living in zones F, G or H	0.38393	-0.15196	0.36665	-0.05901	-0.00168

Table C.2. Average characteristics of firms

in the seven groups obtained through the cluster analysis

Group	N firms	Purchases				Sales				Employment		
		ABC	DE	F	GH	ABC	DE	F	GH	ABC	DE	FGH
I = Local behaviour	816	95.39 (8.82)	3.51 (7.20)	0.63 (2.73)	0.47 (3.64)	96.98 (7.97)	1.86 (5.43)	0.74 (4.03)	0.42 (2.97)	98.53 (6.70)	0.86 (4.97)	0.61 (4.37)
II = Local behaviour with regional purchases	603	29.88 (25.64)	56.28 (31.94)	12.32 (18.24)	1.52 (6.67)	95.39 (9.54)	2.85 (6.56)	1.42 (6.01)	0.34 (2.47)	99.45 (2.93)	0.54 (2.92)	0.01 (0.30)
IV = Local behaviour with national purchases	437	9.96 (12.62)	7.24 (11.39)	80.26 (18.36)	2.54 (7.42)	64.65 (38.32)	11.97 (19.14)	20.49 (32.11)	2.89 (10.35)	93.99 (13.24)	4.94 (11.79)	1.07 (5.94)
V = Local behaviour with national sales	169	80.69 (19.96)	10.57 (14.34)	8.11 (14.29)	0.62 (3.50)	26.42 (24.73)	21.12 (21.93)	51.59 (38.74)	0.87 (3.49)	97.39 (7.88)	1.58 (5.90)	1.04 (5.42)
III = Regional sales & purchases	221	44.43 (34.87)	42.38 (33.20)	10.24 (20.17)	2.95 (11.55)	17.36 (21.82)	70.60 (30.98)	9.30 (20.12)	2.74 (9.52)	99.57 (2.17)	0.43 (2.17)	0.00 (0.00)
VI = International behaviour	265	33.05 (37.94)	8.72 (16.95)	13.37 (22.14)	44.87 (39.61)	23.42 (34.97)	5.93 (12.37)	24.22 (31.48)	46.43 (39.04)	87.33 (23.82)	9.18 (20.55)	3.49 (12.22)
VII = Regional labour market	177	31.64 (34.84)	39.55 (35.71)	26.00 (33.10)	2.81 (10.73)	46.38 (43.02)	25.44 (33.33)	26.43 (37.17)	1.75 (7.15)	40.73 (24.71)	43.04 (31.88)	16.22 (28.18)
Total firms	2688	52.42 (39.83)	24.21 (31.77)	19.24 (31.30)	4.14 (15.70)	68.48 (39.79)	15.39 (28.10)	12.21 (26.78)	3.92 (15.56)	94.04 (17.42)	4.37 (14.73)	1.59 (9.10)

Standard deviations are given in parenthesis.

NOTES

[1] Clearly, this is a broad generalisation relating to the resident population. Tourism, for example, can be a major earner of external income for some rural areas.

[2] The term local economic integration refers to the degree to which a firm carries out its transactions locally. The measure of economic integration used in this paper is based on the proportion of a firm's total economic transactions (input purchases, output sales, employment, consumer goods purchases, etc.) that take place with other entities within given geographical areas or zones. Thus, where a firm exhibits strong integration into the local economy, customers or suppliers in this predefined area account for a large proportion of its respective revenue or expenditure and a large proportion of its workforce is drawn from this same area.

[3] Mills distinguishes: 1) firms established in a particular locality by a local resident, from 2) firms established in that locality by an in-migrant, from 3) firms established elsewhere by an in-migrant and subsequently brought to the locality by that in-migrant.

[4] Of course, division of labour will be limited by the extent of the market. Further, the more specialised (and productive) firms, which demand more skilled labour, are in turn likely to source and trade over longer distances. This in itself may have detrimental effects on the local market.

[5] The selection of a suitably defined boundary is likely to be fairly arbitrary, depending on the objectives of the study. It might be taken as an administrative area (such as a NUTS4 region) or a given distance from the town.

[6] With the available information we can build an additional weighting coefficient combining the previous one with labour market size of the study area in which the firm is located. This double weighting used for calculation of some specific indices allows each firm to represent firms belonging to the same sector and the same study area.

[7] In order to correct the potential bias caused by sampling, we applied to each firm the double weighting described in note 6. This allows each surveyed competitor firm to more closely represent the local population.

[8] In this calculation, we applied to each surveyed household a weight able to represent the demographic population of the study area.

[9] For example, suppose a sawmill uses only two kinds of intermediate goods: 1,000 units of wood and 50 units of other services. It could locate in three types of study area *r*, *r'*, *r''*. If study area *r* is very poor in wood production (local wood suppliers produce only 10 units of wood and other local services produce 100 units), the *IPBR* of this sawmill located in *r* equals 100*[(1000/1050)*(1000/1050-10/110)] + 100*[50/1050*(50/1050-100/110)] = 7.78. If in *r'*, local wood production could exactly meet the demand of firm *i* (local suppliers produce 1,000 units of wood), then $IPBR_{r'}$ = 3.60. Finally, if in *r''* wood production is very large (10,000 units), then the $IPBR_{r''}$ becomes negative and equals -3.56.

[10] Angular transformations were carried out on the dependent variables to improve distribution for OLS analysis.